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are characterised by a breaking away from the narrow limits of the materialistic and agnostic tendencies of the scientific school of France, and venture into broader fields.

Most of the bulletins contain a thesis for a discussion in which the most prominent members take part and thus almost every one of them is actually a symposium, viewing the subject from different standpoints.

Here is a summary of the three volumes: Vol. I, No. 1, M. Le Roy discusses the objective value of physical laws; No. 2, M. Bergson criticises the old views of the psycho-physical parallelism and insists that psychological metaphysics is possible on the basis of positive facts; No. 3, M. André Lalande attempts to elucidate and specify a number of important philosophical terms such as morality, ethics, ethology — the normative (a term coined by Wundt), individuality and personality, virtue, merit, moral value, life, nature; No. 4, M. H. Michel discusses the political doctrines of democracy, in which he defines democracy as that political system which allows each citizen to attain the maximum of his human value.

The second volume contains: No. 1, a discussion of the idea of being, by M. Weber; No. 2, M. Rauh discusses details of the admission to philosophical chairs involving examinations and diplomas; No. 3, M. A. Darlu analyses the contemporary conscience as to the Christian elements it contains; No. 4, M. Couturat explains the relation of logic to metaphysics according to Leibnitz; No. 5, M. Sorel expounds historical materialism, speaking mainly of its social exposition in the works of Marx and Engels; No. 6, M. Belot proposes a thesis on luxury, its effects, its value, and its drawbacks; No. 7 and 8 contain the scheme of a philosophical vocabulary (continued in Vol. III, No. 6 and 7) by MM. Belot, Couturat, Delbos, and Lalande.

The third volume, No. 1, contains M. Émile Boutroux, on Comte's philosophy and metaphysics; No. 2, M. Belot on the place which philosophy should hold in school; No. 3, M. André Lalande on the objective appearance of visual perceptions; No. 4, M. Brunschvicg on the idea of moral liberty; No. 5, M. P. Tannery on the value of Kantian classification of judgments in analysis and synthesis; No. 8, M. G. Tarde on the social philosophy of Cournot.

ELEMENTE DER VEKTOR-ANALYSE. Von *Dr. A. H Bucherer.* Leipsic: Teubner. 1903. Pp. 91.

Since the invention of geometry and algebra, no single advance in mathematics can, perhaps, compare in importance with that introduced by Descartes in 1637, by which geometrical methods are reduced to mere numerical computations.

Disappointment has been felt, in some quarters, that the generalization of Descartes's work which was devised by Hamilton — the Calculus of Quaternions — has not proved itself a more practical and influential mathematical weapon. But it is to be remembered that "natural selection" is a merciless process. Accordingly, just at present, something a little less general than the method of Grassmann and a little less unwieldy than the method of Hamilton appears to be "fittest" and is, therefore, "surviving" easily. It is this modern treatment of vectors, embodying the essential features of the systems of Heaviside, Gibbs, and Grassmann when limited to three dimensions, that Dr. Bucherer gives in the present volume. What then is this Vector Analysis that has grown up between Cartesians and Quaternions? This question is one which can be made easily clear provided the inquirer has already firmly grasped the idea of the complex variable — the "double algebra" of De Morgan — the idea that each equation between complex quantities is equivalent to two equations between real quantities. Just as the complex variable $a + ib$ is a special case of a quaternion, so is the vector $ia + jb + kc$ a special case of Grassmann's n-dimensional vector. The difference between these two algebras lies essentially in the different meanings which are given to products of the operators i, j, and k.

As Tait remarks, the equation $ijk = -1$, together with the equations $i^2 = j^2 = k^2 = -1$, "contains essentially the whole of quaternions." While in vector analysis the corresponding defining equations are $ijk = +1$ and $i^2 = j^2 = k^2 = +1$. Each of the products here mentioned are *scalar* quantities. If we consider *vector* products, we find that the two systems have the following feature in common, namely $ij=k$, $jk=i$, $ki=j$.

To those who are familiar with the elements of physics the difference between scalar and vector multiplication is, perhaps, most easily understood by thinking of the difference between *work* and *torque*, each of which is a product of a force by a distance. In the former case the force and the distance are each in the same direction, while the product, *work*, has no direction and is hence only a scalar. In the latter case, the force and the distance are mutually perpendicular, while the product, *torque*, has a direction (axis) at right angles to both. It is, therefore, a vector.

Returning now to the i, j, k of vector analysis, we have for scalar products, $ij={}^0$, $jk={}^0$, $ki={}^0$.

Vector products $ij=k$, $jk=i$, $ki=j$.

This usage, it will be observed, is quite different from that of the electric engineers who, like Hamilton, employ i as a quadrantal vector.

The volume under review is made up of essentially four parts: (1) a general discussion of vector addition, multiplication and differentiation; (2) applications to some of the simpler problems of dynamics; (3) a brief discussion of the potential theory with electrical applications; and (4) a discussion of the motion of a sphere in a perfect fluid together with the derivation of the general equations.

Students of mathematical physics will be especially interested in the elegant forms here given to Kepler's First Law, the theorems of Gauss and Stokes the two fundamental electro-magnetic equations of Maxwell Green's theorem, the solenoidal condition, the lomellar condition, and numerous other formulæ. The determinantel expressions for curl for vector product, and for certain scalar products are very attractive.

The size of the volume, as it stands, is excellently adapted to the needs of graduate students in physics. When, however, it comes to a second edition the author might find it wise to add a little more "connective tissue." For in discussions of this type it is very easy for every trace of physical meaning to drop out and leave nothing but bare equations — unless interpretation is insisted upon either by author or teacher.

If it were not considered "going over to the enemy," a chapter on the symbolic method employed in the treatment of alternating currents would prove useful and attractive.

The style of the book is clear and altogether admirable. It is to be hoped that it may soon receive an English translation. On page 72, the printer has inserted a gratuitous *r*, thus transforming a distinguished Irish name (Fitzgerald) into perfect German vernacular.

Henry Crew.

Immanuel Kant, ein Bild seines Lebens und Denkens. Von *Dr. Max Apel.* Mit einem Bildnis. Ein Gedenkblatt zum hundertjährigen Todestage des Weltphilosophen. Berlin: Conrad Skopnik. 1904. Pp. viii, 102.

Kant said in his younger years when teaching his students: "Philosophy cannot be learned, for there is no absolute, sure, and universally recognised philosophy. What we can learn, however, is philosophising, viz., we can render clear with a critical spirit the problems in their whole significance and importance." Our author, Dr. Max Apel, adds: "The old master's voice went out from the narrow lecture room into the world and still sounds forth through centuries. Kant has become the philosophical teacher of mankind, but he is not only an incomparable educator in philosophical thinking, he not only makes clear heads and hearts, he is not only the bold revolutionary, but also a powerful creator of new conditions, the thoughtful center of the sciences of human knowledge and action. His philosophy is not *the* philosophy, not *the* truth but it teaches the way to truth. For this reason, one studies Kant's writings more seriously than ever, and must let them pass in spite of all their unavoidable implications and unsolved difficulties."

In the evening of his life, Kant uttered the proud melancholy words:

"I have come with my writings a century too soon. Only after a hun-